CREATING A FIELDBUS STRATEGY BY USING DF51

Introduction

This section describes the strategy configuration by using the DF51 controller as Bridge. The control loop is shown below.

PROJ_DF51

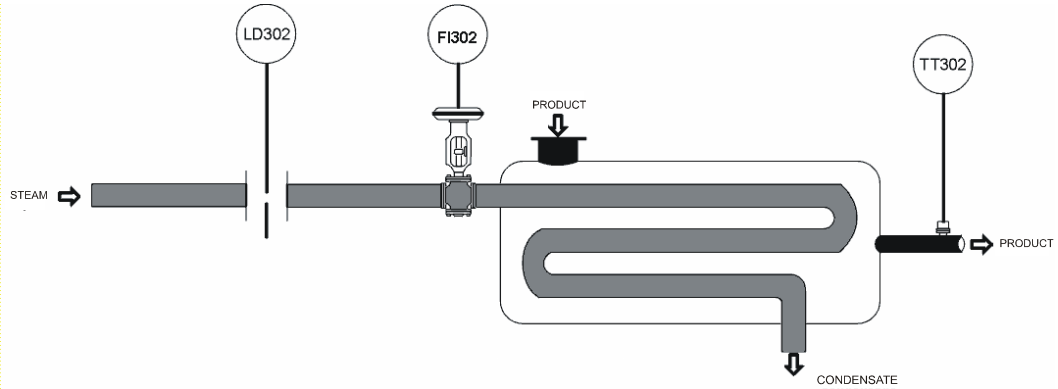

Figure 16. 1 – Example of temperature control process

The purpose of this process is to control the fluid output temperature (controlled variable) using steam flow rate (manipulated variable) to heat it. The fluid temperature will be sent to the master controller, where it will be compared to a temperature set point.

The master output would be the slave controller set point, which will control the steam flow rate to the heat exchanger.

Starting the Area

Step 1
It is possible to create, or edit, an area from the **Studio302**. In the **Studio302** interface select **Areas**. A window will appear listing all areas of database.

To create a new area from the **Studio302**, left-click inside the **Areas** window, then choose **New Area**.

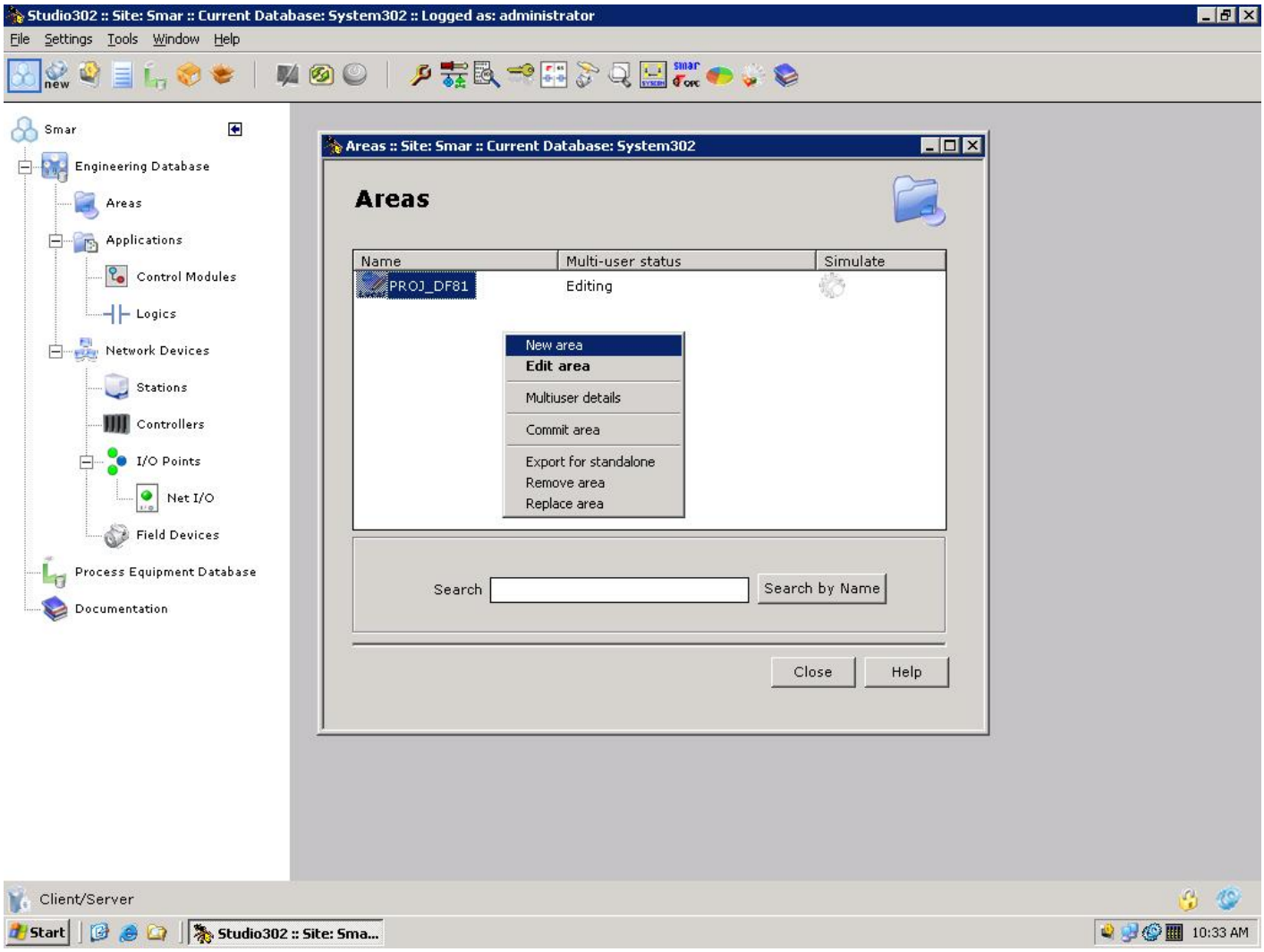

Figure 16. 2 – Creating a new area

Another way to create a new area is from **Syscon.** Click the icon in the **Studio302** toolbar.

To create a new area on **Syscon**, choose **File → New**, or through the toolbar, choose **New** button . The dialog box shows the areas options. Select **Area** as shown in next figure:

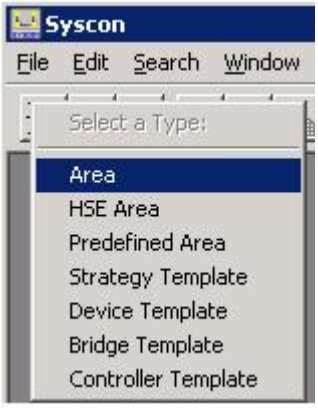

Figure 16. 3 – Options to create Syscon areas

After choosing the area type, it opens a window to the user give a name to the new area.

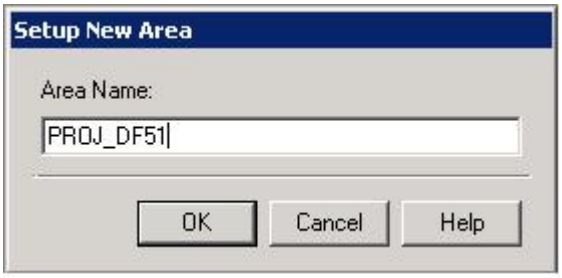

Figure 16. 4 – New area name

Type the name for the area in the **Area Name** box, and click **Ok**. For this example, it chooses **Proj_DF51** name.

A new window will appear. This window has:

- **Application** – Logical Plant. To insert control strategies into this part.
- **Fieldbus Networks** – Physical Plant. To add devices and function blocks to the area into this part.

Figure 16. 5 – Area divisions

Physical Plant Project

Step 2

In the main window, **PROJ_DF51**, right-click the **Fieldbus Networks** icon, , to select the Server. Choose **Communication Settings** option, or through the toolbar, choose **Communication→Settings**. The communication settings dialog box will open:

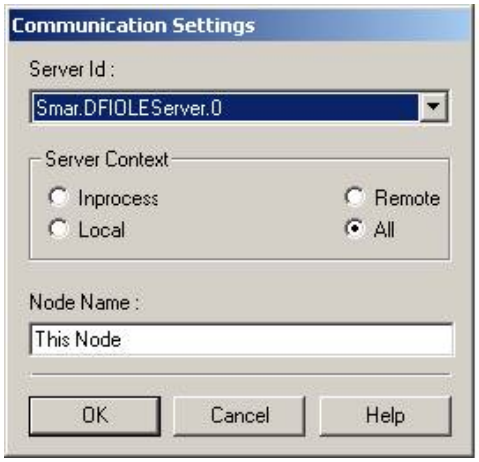

Figure 16. 6 – Choosing the Server

Confirm if the **Smar.DFIOLEServer.0** option has already been selected. Otherwise, the user must select it, and then click **OK**.

Arranging Fieldbus windows

Step 3

Right-click the **Fieldbus Networks** icon, and then choose **New Fieldbus** option.

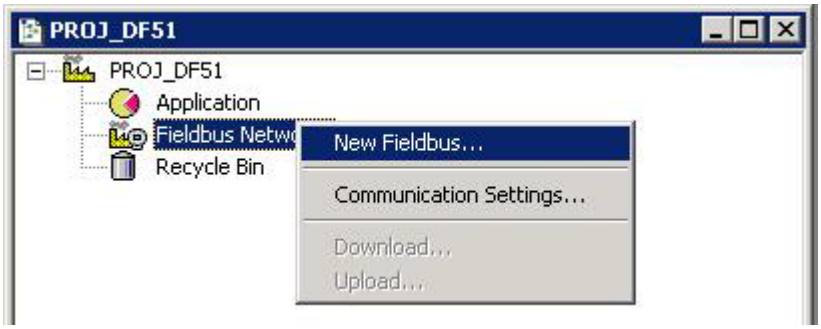

Figure 16. 7 – Adding a Fieldbus channel

When selecting the **New Fieldbus** option, the dialog box to choose the channel type and name it with tags opens. If the user needs to name the channel with a specific tag, it must be written in this box. After that, click **OK**. Otherwise, the default tag will be attributed to the channel.

Figure 16. 8 – Selecting the Fieldbus channel and naming it with a tag

In the **PROJ_DF51** window, the **CANAL_00** will be inserted into the **Fieldbus Networks**:

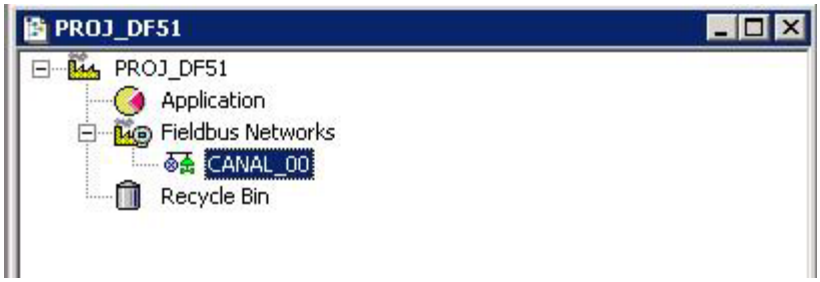

Figure 16. 9 – Fieldbus channel inserted

Right-click the **CANAL_00** icon and choose **Expand**. A new window will appear.

To arrange the screen, click the main area window. So, choose **Window** menu on the **Syscon** toolbar, and then choose **Tile** option.

Adding Bridges

Step 4

Now the bridges that will be used for this area can be added.

First, the DF51 controller must be inserted. In the **PROJ_DF51** window, right-click the **CANAL_00** icon. Select **New →Bridge** as shown in the next figure:

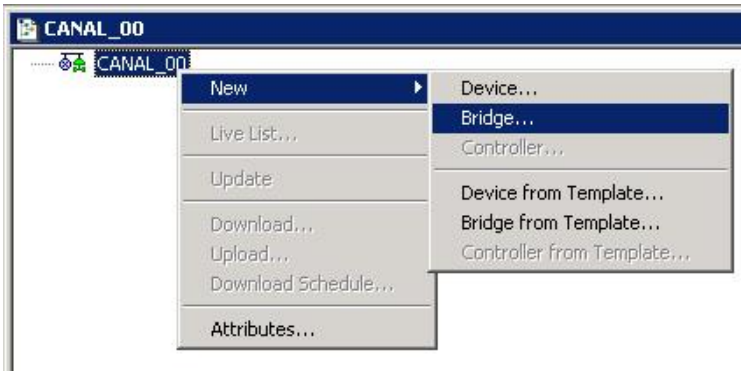

Figure 16. 10 – Inserting the bridge to the area

After inserting the Bridge, it opens a window as shown below.

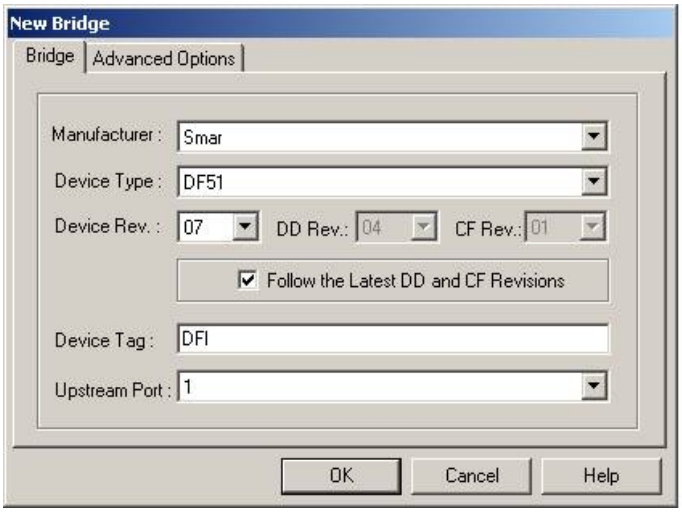

Figure 16. 11 – Setting the Bridge

Select **DF51** in the **Device Type** box. In the **Device Tag** box, type **DFI** or another tag, and click **OK**.

IMPORTANT

Not all characters are valid when naming the elements, so pay attention:
The valid characters are:
`A-Z a-z 0-9 # { } [ ] ( )+ -`
The invalid characters are:
`~ ` ! @ # $ % ^ & * = | : ; , . < > ? / ' " \`

In the **CANAL_00** window**,** right-click the **DFI** icon, , Select **Attributes** option to see the bridge's attributes and, if necessary, change its tag. Click **OK**. See the next figure:

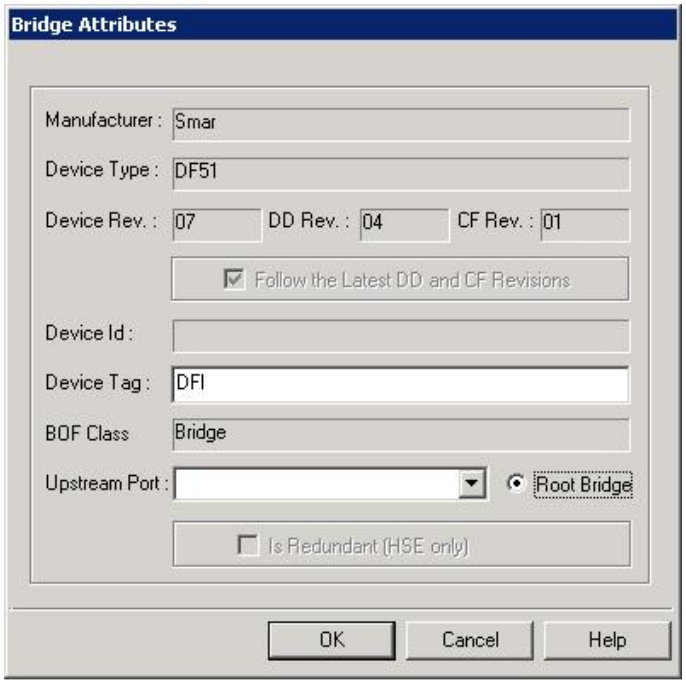

Figure 16. 12 – Bridge attributes

Adding Fieldbus Devices

Step 5

After adding the bridge for the area, it is possible to insert the field devices. First, return to the **PROJ_DF51** window and right-click the **CANAL_00** channel. Select **New→Device**

The dialog box for choosing the device and naming it with a tag will be shown. The user can select **Smar** in the **Manufacturer** box, select **TT302** in the **Device Type** box, and then name this device with the tag **TIC001**, or with another tag. After finishing, click **OK**:

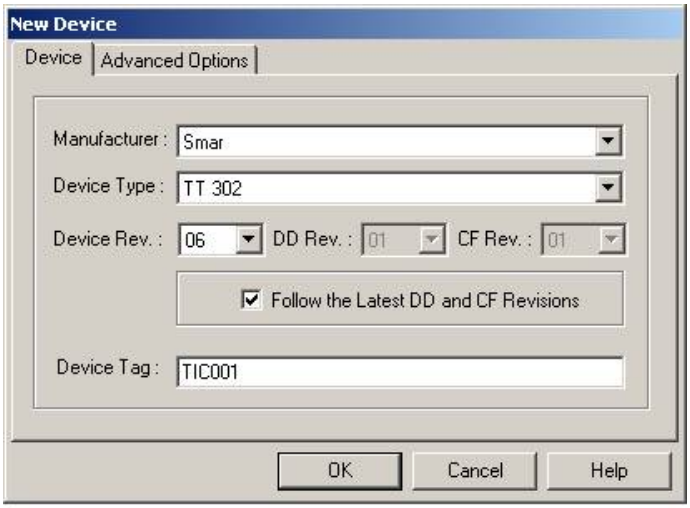

Figure 16. 13 – Setting the Fieldbus Device

Repeat this procedure to add a transmitter (LD302) and a converter (FI302) in the flow control.

After adding the devices to the area, the **CANAL_00** channel will be as shown in the following figure:

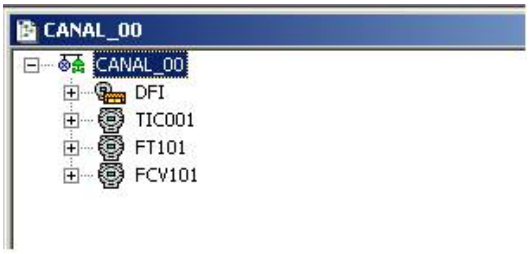

Figure 16. 14 – Device added into the Fieldbus channel

Adding Function Blocks

Step 6

Now the user can add Function Blocks. To add a new Function Block (FB), click the sign, and right-click the **Virtual Field Device** (**FB VFD**) icon. Select **New Block** item.

The FB VFD is responsible for the data management.

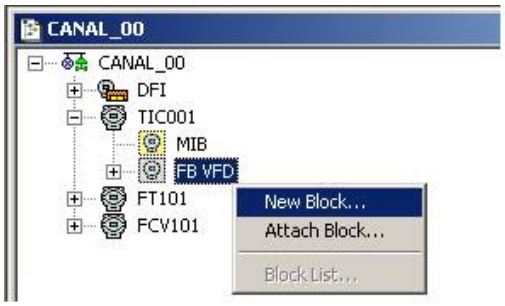

Figure 16. 15 – Selecting new blocks

The **Function Block Characterization** dialog box will appear. The **Block Type** option shows the Smar's FB.

Select the block in the **Block Type** box and name it in the **Block Tag** box. The next figure shows adding the Analog Input function block.

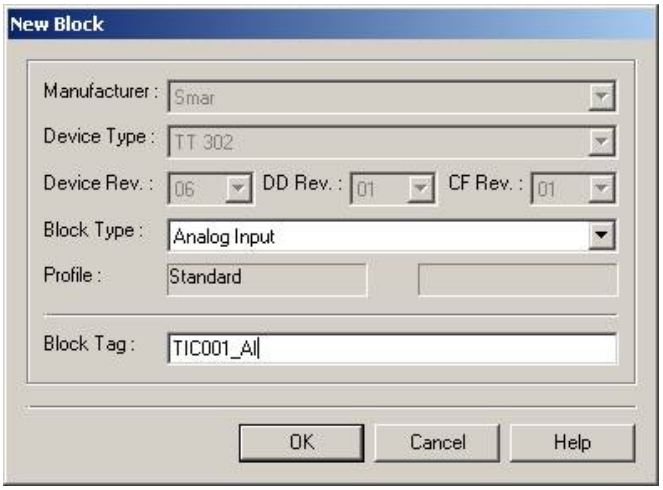

Figure 16. 16 – Adding function blocks to the device

For this example, it is necessary to add AI, PID and AO function blocks to build a cascade control configuration.

NOTE
From the **Syscon** version 6.00, it is not necessary to configure the Transducer (TRD), Resource Block (RES), Diagnostics (DIAG) and Display (DSP) blocks, because they are preinstantiated in the devices.

The channel configuration with all function blocks and devices is showed below. For better identification of the Transducer, Resource and Diagnostics function blocks name them with specific tags.

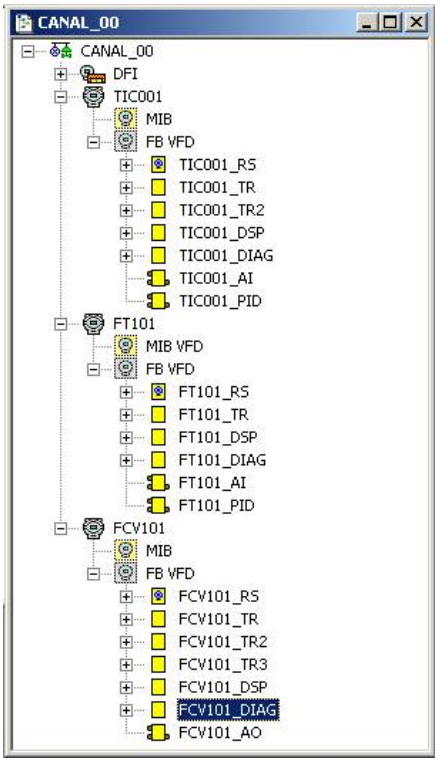

Figure 16. 17 – Fieldbus channel composition

Now the strategy on the Application (Logical Plant) can be developed. First it is necessary to establish a new process cell.

Creating New Process Cells

Step 7

The **Logical Plant** can be divided in several process cells, according to the plant.

To create a new process cell, right-click the **Application** icon and select **New Process Cell** item.

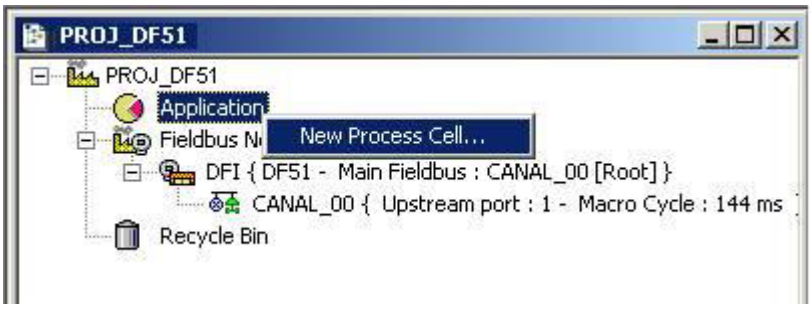
PROJ_DF51
PROJ_DF51
Application
Fieldbus N
New Process Cell...
DFI { DF51 - Main Fieldbus : CANAL_00 [Root] }
CANAL_00 { Upstream port : 1 - Macro Cycle : 144 ms
Recycle Bin

Figure 16. 18 – Adding a Process Cell

The dialog box to attribute the tag to the **Process Cell** will open:

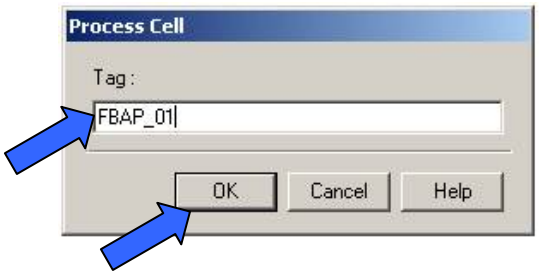

Figure 16. 19 – Attributing tag to the Process Cell

If the user needs name the Process Cell with a specific tag, can enter it in the **Tag** box, and click **OK**. To create more process cells, the procedure above has to be repeated.

After inserting the Process Cell, the **PROJ_DF51** window will be according to the following figure:

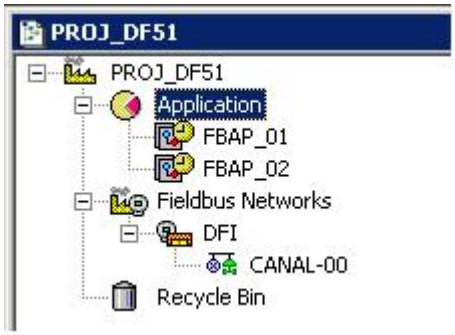

Figure 16. 20 – Area window after inserting the Process Cell

NOTE
The user must remember that **Application** is a virtual division. It only divides a large plant. For example: if the plant has two networks, they can be FB (**FBApplications)** in the **Syscon**. One **Application** can have several **FB Applications**, but a **FB Application** can not be in more than one **Application.**

Creating a Control Module (FBApplication)

Step 8

Now the user can create a Function Block Application, Control Module, in the **Application** section.

Right-click the **FBAP_01** icon and select **Expand** item.

Figure 16. 21 – Creating a FB Application

To arrange the screen, click the area window. So, choose the **Window** menu on the **Syscon** toolbar and then choose **Tile** option.

Return to the **FBAP_01** window. Right-click the **FBAP_01** item and choose **New Control Module**. See the next figure.

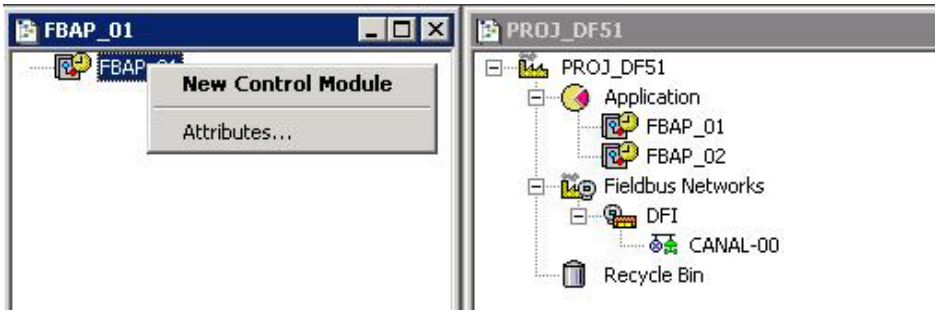

Figure 16. 22 – Creating the new Control Module

The **Control Module** dialog box will appear. Name it with a tag related to the Process Cell. Click **OK** to conclude this task.

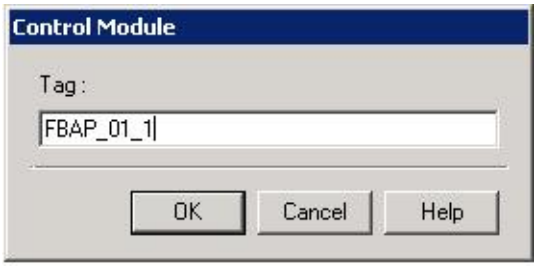

Figure 16. 23 – Attributing tag to the Control Module

IMPORTANT
Remember that not all characters are valid when naming the elements with tags. The valid characters are: A-Z a-z 0-9 # { } [ ] ( )+ - The invalid characters are: ~ ` ! @ # $ % ^ & * = | : ; , . < > ? / ' " \

Inserting Blocks in the Control Module

Step 9

Now the user can add function blocks for the devices in the Logical Plant. Right-click the **FBAP_01_1** item and select **Attach Block** option, as shown in the next figure.

Figure 16. 24 – Attaching blocks to the FBAP

The **Attach Block** dialog box will open:

Figure 16. 25 – Inserting blocks to the FB Application

The available function blocks for the Control Module are showed in the **Attach Block** box. For the aimed strategy, the function blocks that must be inserted will appear in the box. So, select them one by one, and click **OK**.

When the Attach Block process ends, the Control Module will be as shown in the next figure:

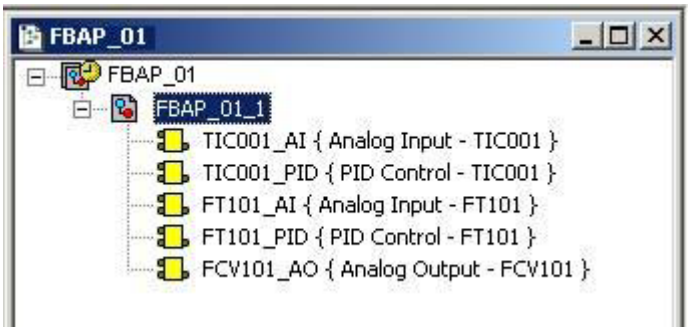
FBAP_01
FBAP_01
FBAP_01_1
TIC001_AI { Analog Input - TIC001 }
TIC001_PID { PID Control - TIC001 }
FT101_AI { Analog Input - FT101 }
FT101_PID { PID Control - FT101 }
FCV101_AO { Analog Output - FCV101 }

Figure 16. 26 – Blocks added to the FB Application

Another way to attach the blocks to the Control Module is left-clicking the element and drop it to the window.

Configuring the Control Strategy

Step 10

Now the user is ready to develop the control strategy.

First, right-click the FBAP icon and choose **Strategy**. The **Strategy** window will appear as shown in the following figure.

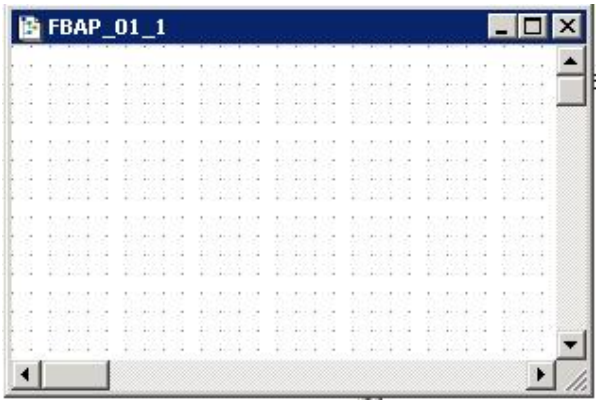

Figure 16. 27 – Strategy window

At this moment there are 3 or 4 windows opened in the **Syscon**. Minimize the **CANAL_00** window. To arrange these windows, click the **FBApplication** window, and then the **Proj_DF51** window**.** On the toolbar, choose **Window → Tile**.

If the user does not have a monitor upper than 17", it is recommended to minimize the strategy window. Thus the whole area can be visualized.

The strategy window offers several tools for drawing. Refer to the **Syscon**'s Help for further details.

Adding Blocks to the Strategy window

Step 11

Now the function blocks can be added to the **FBAP_01_1** window.

In order, click the first block,

, and drop it into the strategy window. A function block will be created automatically.

The following figure shows the function block added to the strategy window:

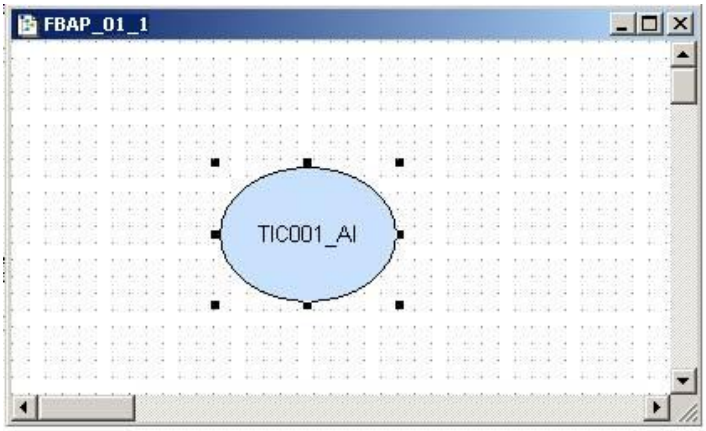

Figure 16. 28 – Block inserted into the strategy window

The drag-and-drop procedure must be repeated for the other blocks such as TIC001_PID, FT101_AI, FT101_PID e FCV101_AO.

Linking the Blocks

Step 12

There is a specific tool to link the blocks, the **Link** button, , on the **Strategy** toolbar.

Click this button on the toolbar, and then in the TIC001_AI function block. The dialog box for linking the input and output parameters will appear. Select **OUT,** and then click the **OK** button as shown in the following figure.

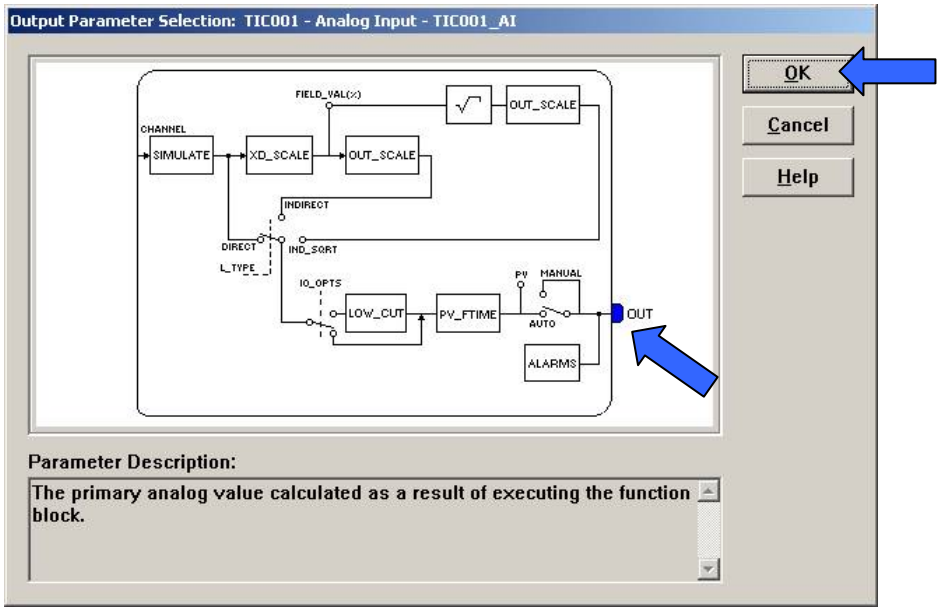

Figure 16. 29 – Linking the function blocks

Move the mouse cursor up to the block that will be linked.

The user also does the fast link procedure just right-clicking the function block.

The links necessary for this strategy are:

Direct Links:

- OUT(TIC001_AI) ➔ IN(TIC001_PID)
- OUT(TIC001_PID) ➔ INFT101_PID)
- OUT(FT101_PID) ➔ CAS_IN(FCV101_AO)
- OUT(FT101_AI) ➔ CAS_IN(FT101_PID)

Back Links:

- BKCAL_OUT(PID_LD302) ➔ CAS_IN(PID_TT302)
- BKCAL_OUT(AO_FI302) ➔ BKCAL_IN(PID_LD302)

After linking the parameters specified above, the strategy window will be as shown in the following figure.

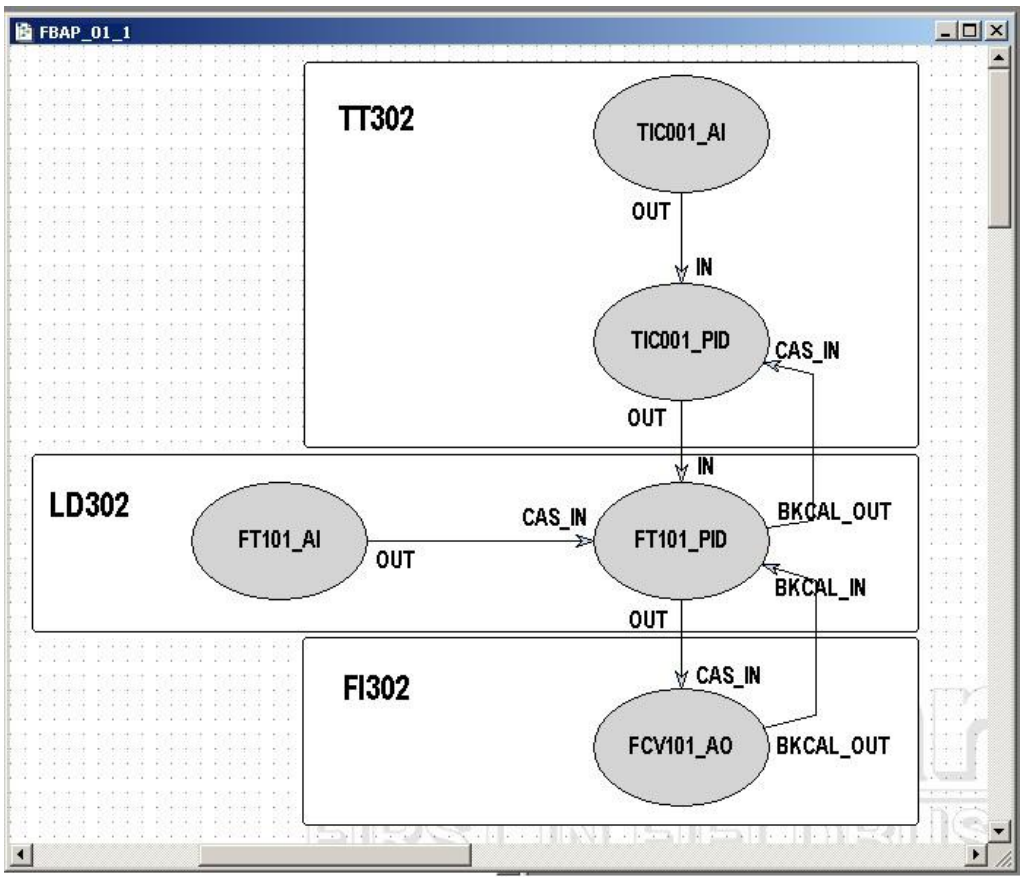

Figure 16. 30 – Links among function blocks

Function Block Characterization

Step 13

The function blocks must be set according to the application for them. So, it is necessary to do the block characterization.

The online and offline modes are possible for the block characterization. In the offline mode, the parameters are set before starting the communication between the devices. The online characterization is executed directly in the devices when the plant is already communicating.

To change the function block parameters, consider the following topics:

1. In the Strategy window

Select the block to characterize. Right-click it, and select the **Off Line Characterization** option, or double-click it. The following figure shows the block that is being done the offline characterization:

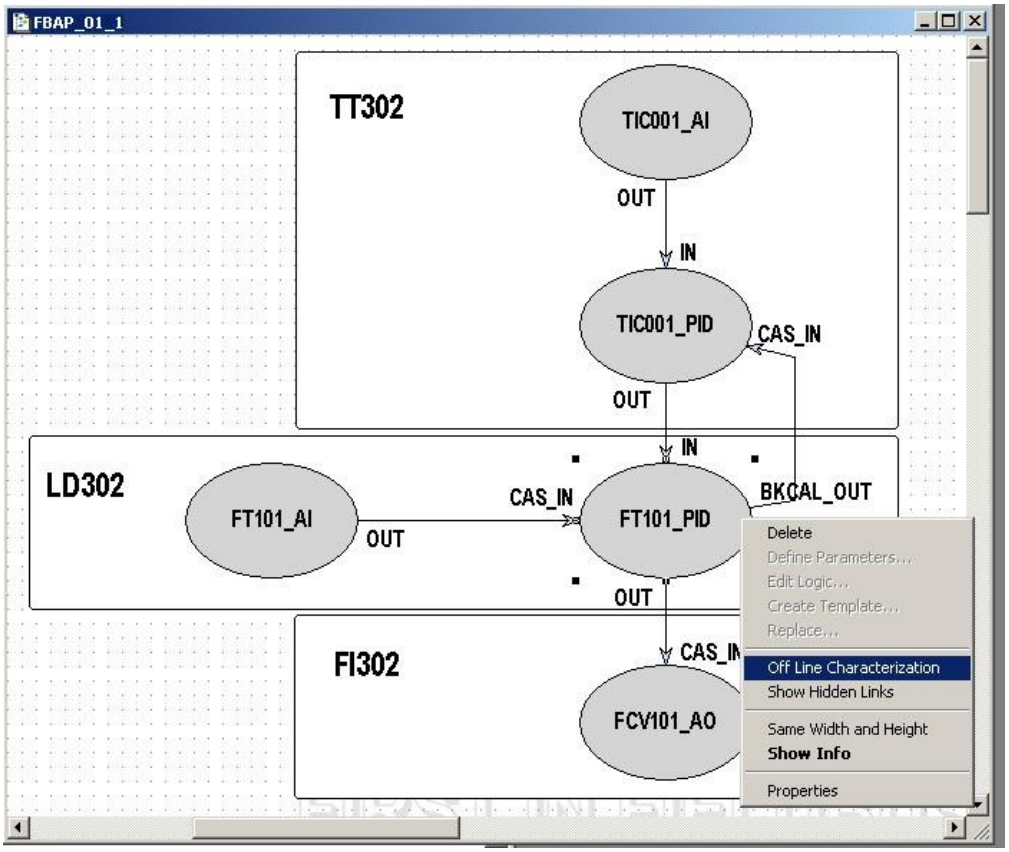

Figure 16. 31 – Offline characterization in the Strategy window

2. In the CANAL_00 window

Another way to do the offline characterization is right-clicking the function block, and then selecting the **Off Line Characterization** option, as shown in the next figure:

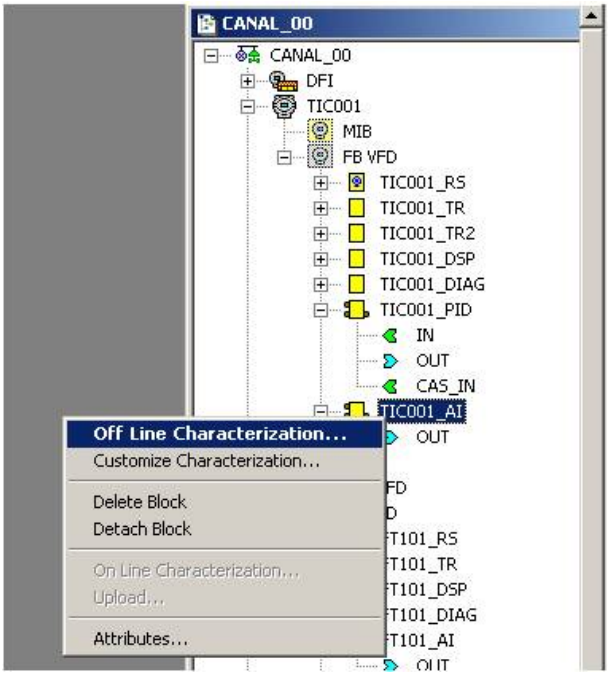

Figure 16. 32 – Offline characterization in the Fieldbus channel window

For both situations, the **Off Line Characterization** dialog box will appear:

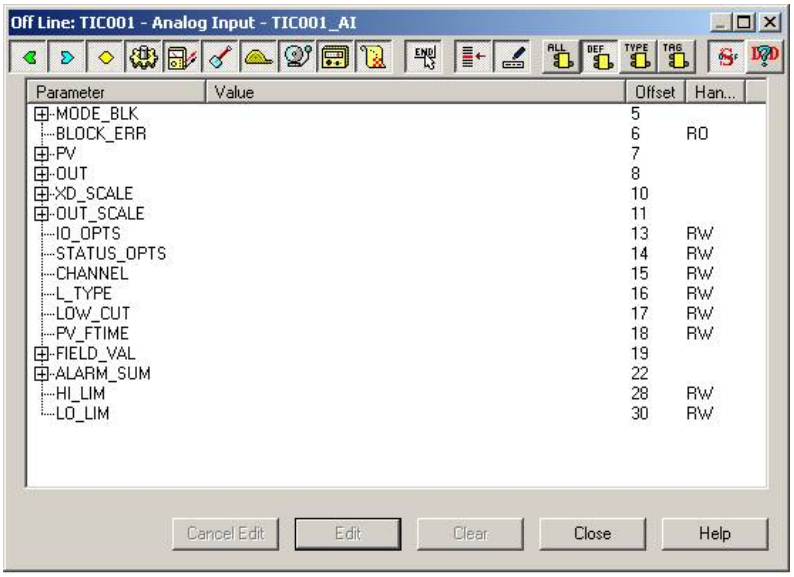

Figure 16. 33 – Function Block Characterization dialog box

Double-click at the right side of the parameter to change it. Another option is click once, and then in the **Edit** button to start editing the parameter value. At the ending, click the **End Edit** button.

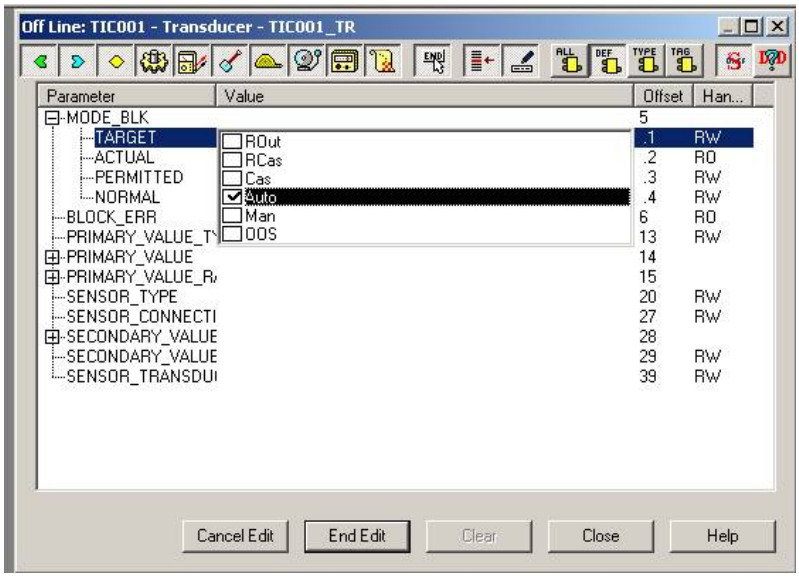

Figure 16. 34 – Editing the parameter in the Function block Characterization box

The list below shows the parameters that must be set for this area:

DEVICE	TAG	BLOCK	PARAMETER
LD302	**FT101**	TR	MODE_BLK.Target = AUTO
		RS	MODE_BLK.Target = AUTO
		DSP	MODE_BLK.Target = AUTO
			BLOCK_TAG_PARAM_1= FT101_AI
			INDEX_RELATIVE_1 = 8
			MNEMONIC_1 = VAZAO
			ACCESS_1 = MONITORING
			ALPHA_NUM_1 = MNEMONIC
			DISPLAY_REFRESH = UPDATE DISPLAY
		AI	MODE_BLK.Target = AUTO
			XD_SCALE.EU_100 = 100 XD_SCALE.EU_0 = 0 XD_SCALE.UNITS_INDEX = inH2O(4ºC)
			OUT_SCALE.EU_100 = 100 OUT_SCALE.EU_0 = 0 OUT_SCALE.UNITS_INDEX = %
			CHANNEL = 1
			L_TYPE = INDIRECT
		PID_1	MODE_BLK.Target = AUTO
			PV-SCALE.EU_100 = 100 PV-SCALE.EU_0 = 0 PV-SCALE.UNITS_INDEX = %
			OUT_SCALE.EU_100 = 100 OUT_SCALE.EU_0 = 0 OUT_SCALE.UNITS_INDEX = %
			GAIN = 0.5
			RESET = 1
			RATE = 0

DEVICE	TAG	BLOCK	PARAMETER
TT302	**TIC001**	TR	MODE_BLK.Target = AUTO
			SENSOR_TYPE = PT100IEC
			SENSOR_CONNECTION = THREE WIRES
			SENSOR_TRANSDUCER_NUMBER = 1
		RS	MODE_BLK.Target = AUTO
		DSP	MODE_BLK.Target = AUTO
			BLOCK_TAG_PARAM_1 = TT100_AI
			INDEX_RELATIVE_1 = 8
			MNEMONIC_1 = TEMP
			ACCESS_1 = MONITORING
			ALPHA_NUM_1 = MNEMONIC
			DISPLAY_REFRESH = UPDATE DISPLAY
		AI	MODE_BLK.Target = AUTO
			XD_SCALE.EU_100 = 500 XD_SCALE.EU_0 = 0 XD_SCALE.UNITS_INDEX = ºC
			OUT_SCALE.EU_100 = 100 OUT_SCALE.EU_0 = 0 OUT_SCALE.UNITS_INDEX = %
			CHANNEL = 1
			L_TYPE = INDIRECT
		PID	MODE_BLK.Target = AUTO
			PV_SCALE.EU_100 = 100 PV_SCALE.EU_0 = 0 PV_SCALE.UNITS_INDEX = %
			SP = 50
			GAIN = 0.5
			RESET = 1
			RATE = 0

DEVICE	TAG	BLOCK	PARAMETER
FI302	**FCV101**	TR	MODE_BLK.Target = AUTO
			TERMINAL_NUMBER = 1
		RS	MODE_BLK.Target = AUTO
		DSP	MODE_BLK.Target = AUTO
			BLOCK_TAG_PARAM_1 = FCV102_AO
			INDEX_RELATIVE_1 = 9
			MNEMONIC_1 = VALVULA
			ACCESS_1 = MONITORING
			ALPHA_NUM_1 = MNEMONIC
			DISPLAY_REFRESH = UPDATE DISPLAY
		AO	MODE_BLK.Target = AUTO
			PV_SCALE.EU_100 = 100 PV_SCALE.EU_0 = 0 PV_SCALE.UNITS_INDEX = %
			XD_SCALE.EU_100 = 20 XD_SCALE.EU_0 = 4 XD_SCALE.UNITS_INDEX = mA

After the parameter setting, the user can start the equipment communication. It is necessary commissioning the devices in order to attribute the tags, IDs and device addresses properly. If this procedure is not executed, the **Syscon** will detect the noncommissioned device and the download for this device will be aborted. Finishing the equipment commissioning, the download process can start. The download process can be executed, for example, returning to the **Proj_DF51** window, right-clicking the **Fieldbus Networks** icon, , and selecting the **Download** option. For further details about the available download types, refer to the **Syscon** manual.

Optimizing the Supervision

There are some important steps to be done in the DF51 configuration that can improve the supervision time. Before starting these procedures, a brief description of the System302 architecture is presented to facilitate the understanding of the effects of changes in each parameter.

Take a look in the next figure. The user will be able to follow the data flow from source (field device) to the destination (HMI). Starting in the field device, the data is collected by DFI302 during the **Background** time included in the Fieldbus macrocycle. When using **MVC** (Multiple Variable Container), these data are grouped in an optimized way. The **Supervision Time** controls the rate that a MVC is read from the field device. Each **Update Time**, DFI302 sends the data to DFI OLE Server which updates its database. All the OPC Groups will be updated according to the **OPC Update Rate**.

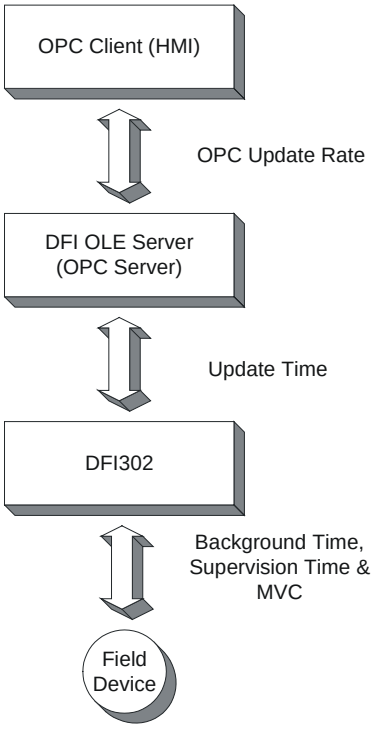

Figure 16. 35 – SYSTEM302 Architecture

The next steps must be configured in order to get a better and optimized time for each system.

Background time

One of the first parameters to be set is Background time (or Background traffic). The **Syscon** calculates the macrocycle according to the number of links in the configuration and allows the user to add a Background time. A minimum value is automatically set by **Syscon**, and must be calculate to have an ideal background to each Fieldbus Network.

The Background time is calculated based on the formula used for the Fieldbus macrocycle. The macrocycle is composed of Operational and Background traffics.

The ideal macrocycle for non-Redundant Systems is:
Ideal macrocycle non-Redundant = ((30*NDEV)+(30*NEL))*1.2

The ideal macrocycle for Redundant Systems is:
Ideal macrocycle Reduntant = ((60*NDEV)+(30*NEL))*1.2
Where, NDEV is the Number of Field Devices in the Fieldbus Network
NEL is the Number of External Links (between Field Devices)

After you know the ideal macrocycle, go to Fieldbus Attributes on **Syscon** and adjust the Background Traffic to the new and acceptable value.

IMPORTANT
Once adjusted in every Fieldbus Channel, run a complete configuration download.

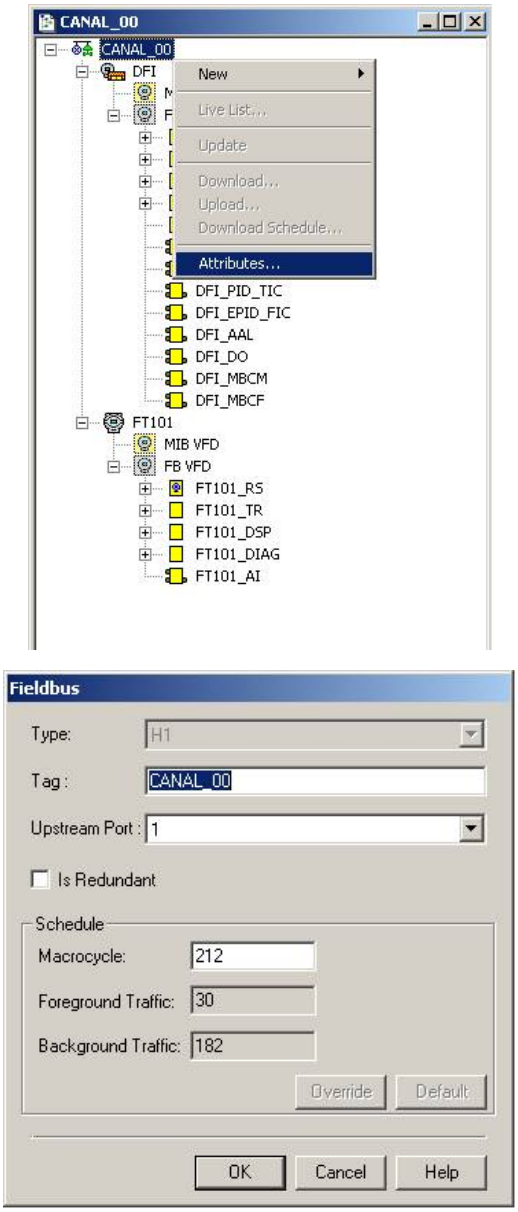

Figure 16. 36 – Adjusting the macrocycle

MVC (Multiple Variable Containers)

Multiple variable containers are a data container that will have all device data. If this parameter is disabled, the data are sent through block views. Each block has four views that give a lot of overhead to the communication.

The MVCs come to optimize this communication sending only one big packet per device instead of four small ones per block. Just set the **MVC_ENABLE** parameter inside the **DF51 Transducer Block** to enable this feature. All changes done on this parameter will take effect only after new Supervision startup.

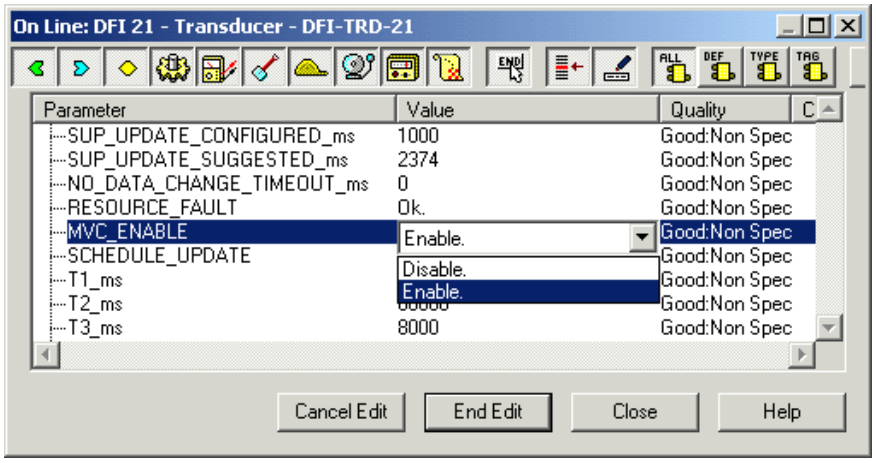

Figure 16. 37 – Setting the MVC_ENABLE parameter

Supervision Time

The Supervision Time is the time required for the DF51 to collect all field device's data and submit to the supervision workstation. Remember that these data are sent through the Background time of the macrocycle.

During the Supervision time, the internal database is refreshed. Therefore, this procedure only makes sense in a system that is already up and running, together with all HMI (Human Machine Interface) software.

The DF51 transducer block has three other parameters that are also used to optimize the supervision in System302.

• Parameter 1: **SUP_UPDATE_CONFIGURED_ms**
• Parameter 2: **SUP_UPDATE_SUGGESTED_ms**

These two parameters define the time that the bridge has to poll the supervision data from the devices. Start setting up the **SUP_UPDATE_CONFIGURED_ms** as 2 times the ideal macrocycle. After 10 minutes approximately, the parameter **SUP_UPDATE_SUGGESTED_ms** will indicate an optimal time and a change may be done again.

• Parameter 3: **NO_DATA_CHANGE_TIMEOUT_ms**

On data change is a mechanism to optimize the data transference between the bridge and the HMI software. With this mechanism the bridge will only send data that has changed.

The HMI has a timeout for the data, i.e., if it does not receive a communication point after a certain period it will indicate lack of communication. Here is the point where **NO_DATA_CHANGE_TIMEOUT_ms** comes in. This parameter defines the timeout to the bridge. If a certain value does not change over that period, it will be sent to the HMI anyway, avoiding the expiration of the HMI timeout.

NOTES
- Good values for the **NO_DATA_CHANGE_TIMEOUT_ms** parameter are between 2500 and 6000, depending on the loaded configuration. - All the changes done on this parameter takes effect after new Supervision startup.

Update Time

The **UPDATE_TIME** is used by DF51 to refresh the DFI OLE Server database.

Normally only the dynamic data are refreshed. Static data are refreshed each **NO_DATA_CHANGE_TIMEOUT**.

Using **Syscon**, open the Online Characterization for DF51 Transducer Block, and adjust the parameters **UPDATE_TIME** and **NO_DATA_CHANGE_TIMEOUT** to the values. Have in mind that adjusting **UPDATE_TIME** to 200 ms, the DF51 will refresh the data more frequently than the default value (1000 ms) and it will load a little bit more the Ethernet traffic.

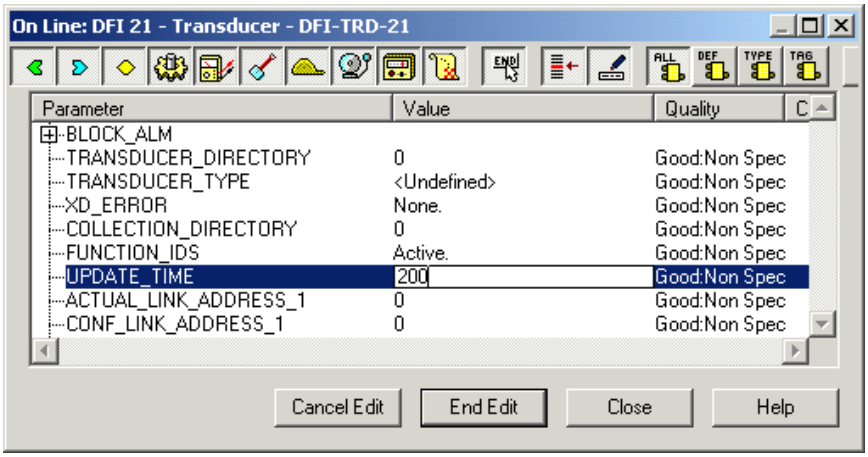

Figure 16. 38 – Setting the UPDATE_TIME parameter

OPC Update Rate

The client (HMI) can specify an "update rate" for each group. This determines the time between when the exception limit is checked. In other words, if the group is set to 1 second, but the data is changing each 500 ms, the client will be advised each 1 second. The update rate is a request from the client and the server will respond with an update rate that is as close as possible to that requested.

Each client has specific ways to configure this rate. Consult the manual for the HMI and do it as necessary.

ADDING REDUNDANCY TO THE DF51 CONTROLLER

Introduction

The main key for fault tolerance and in order to achieve the great system availability is to have redundant devices. DF51 controllers are able to work in a Hot Standby* redundancy mode, which offers redundancy for all its functionalities and databases.

Also there is an option to work with the legacy mode LAS (Link Active Scheduler) redundancy. This chapter will present the characteristics of each mode and the procedures that the user should follow to configure the system in a redundant way. Here follows an overview of the modes.

Hot Standby Redundancy

With the Hot Standby mode full redundancy is achieved, heavily improving the plant availability and safety. This mode offers redundancy for all the DF51 functionalities and databases:

- Gateway: 1 Ethernet port ↔ 4 H1 ports;
- Link Active Scheduler (LAS);
- Controller (running Function blocks);
- Modbus Gateway.

NOTE
A **Link Active Scheduler (LAS),** equipment is the entity in the FOUNDATION™ fieldbus H1 network responsible for coordinating the communication, i.e. it basically dictates when each device is allowed to publish/subscribe data to/from the FOUNDATION fieldbus H1 network.

That is, the same redundancy capability achieved with the legacy mode “LAS redundancy”, with the Hot Standby mode is achieved too.

This mode suits specially the cases where the DFI302 has function blocks in its configuration. Function blocks on DFI302 can be interesting mainly in two cases:

- Integration to legacy systems through Modbus protocol (using Modbus function blocks);
- Advanced function blocks or strategies (DFI302 execute function blocks with much better performance than the field devices).

The procedures for configuration and maintenance are as simple as for a non-redundant system, saving time to get the system running. Only one configuration download is necessary to configure the redundant pair at the first plant start-up. And in the case of replacement of a failed module none download of configuration or user intervention is necessary. The new module inserted is automatically commissioned, receiving the whole configuration from the module in operation.

Since the system supports the modules placed physically separated (even far from each other), common fault causes are avoided. In other words, with the processor modules placed at different backplanes, or even at different rooms, failures in one of the backplanes or in one of the rooms will not affect the whole system.

* Hot Standby: “Redundancy strategy where the Standby module is powered and synchronized with the Active module, standing ready to assume if necessary”.

NOTES
- The 4TH FOUNDATION fieldbus H1 channel is used as the synchronization path between the modules. Thus, this channel will not be used as a usual FOUNDATION fieldbus H1 channel and should not have devices connected. - DF51 in Hot Standby mode uses the flat address "0x05" when it publishes. Because third-party devices do not support the flat address, they are not able to establish links with the DF51 in Hot Standby redundancy. - Hot Standby redundancy is available only for **SYSTEM302** Version 6.1.7 and above.

Link Active Scheduler (LAS) Redundancy

This is a legacy mode of redundancy suitable only for the case where DF51 does not have function blocks in its configuration. That is, in such case the function blocks are on the field devices. This is a completely distributed control philosophy where DF51 perform two main functions:

- Gateway: 1 Ethernet port ↔ 4 H1 ports;
- Link Active Scheduler.

For this scenario, with the LAS redundancy the control, operation, and supervision redundancies are also guaranteed.

Redundant System Architecture

In order to have a true redundant system, not just all the devices must be redundant but also the entire system topology must be thought as redundant. The more elements with redundancy ability the system have, better reliability and availability can be achieved. A typical and simple redundant topology based on DF51 can be seen in figure 17.1.

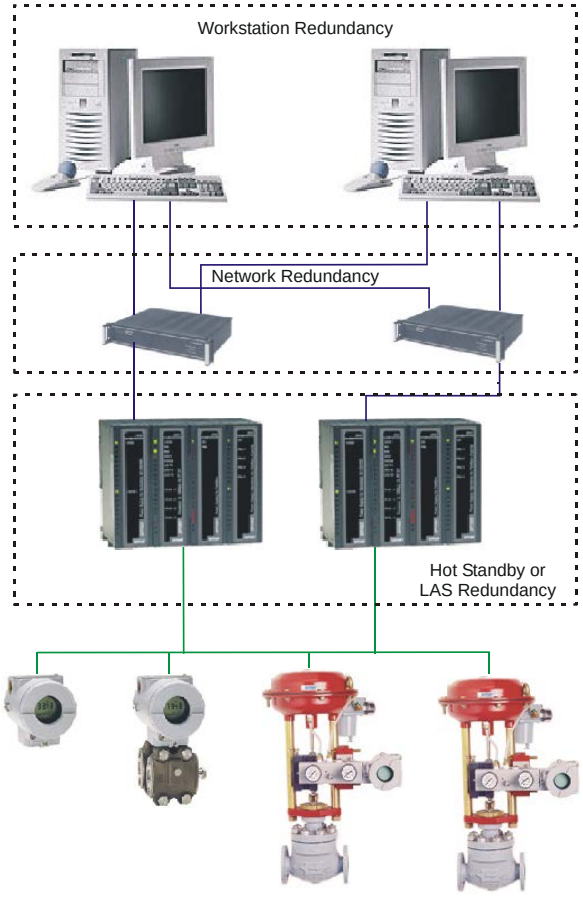

Figure 17.1 – Redundant System Architecture

System Pre-requirements

The requirements listed here apply to both redundancy modes.

The version of firmware for redundant systems has the termination "R". It indicates a firmware suitable for redundant applications. With the redundant firmware, the module initializes by default in Hot Standby mode, in a safety state called “Sync_Idle”. The user as will be seen forth can change the redundancy mode later, if necessary.

The **Syscon** configuration should be created as it is usually done for a non-redundant system (in case of questions, please refer to section 3 of this manual). The unique difference (now that redundancy is involved) is that it is necessary to add a transducer function block to the bridge. This transducer will be used then to initialize the redundancy.

In the **Syscon** configuration, the tag for the transducer block can be any, preferentially a meaningful tag concerned to the DF51 tag or to the plant. Be careful to not use tags already in use in the same plant. Further information on **Syscon** operation, can be found in its own manual.

For any of the redundancy modes it is necessary first of all to configure the network redundancy. Refer to the Configuring Servers section for further details.

Configuring Hot Standby Redundancy

In order to enable the Hot Standby redundancy and monitor its status, some parameters available in the DF51 transducer block should be used.

Most redundancy parameters have a suffix. The suffix “L” means Local, or that the parameter brings information of the module that is being monitored directly through the DFI OLE Server. The suffix “R” means Remote, or that the parameter brings information that the Local module knows about the other module through the synchronization path.

Here is presented a functional description of these parameters in order to understand how the Hot Standby redundancy works. For further information on these parameters see also the transducer block description table (Function Blocks manual).

TAG_DESCRIPTION

This parameter shows the DF51 serial number to allow the identification of controller with problem.

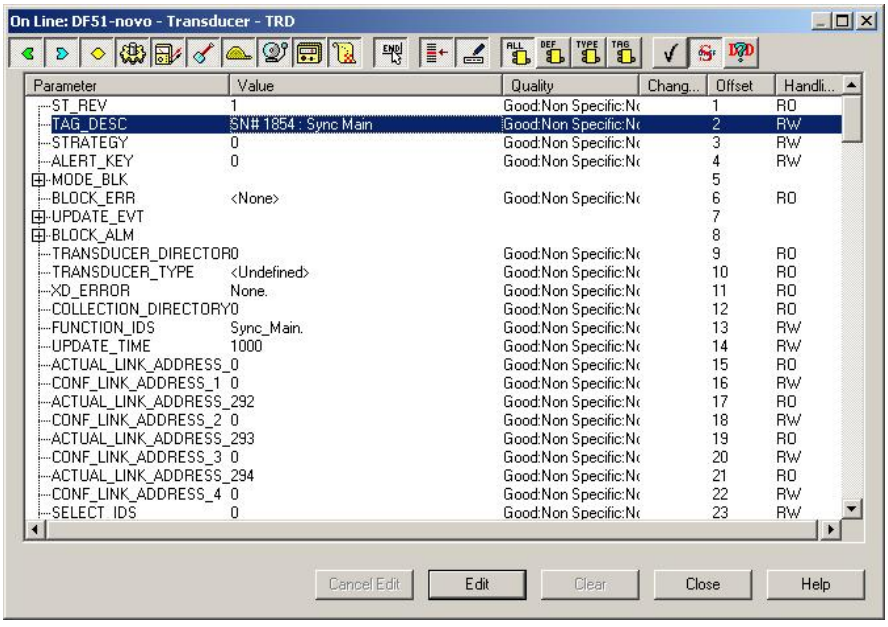
On Line: DF51-novo - Transducer - TRD
Parameter
Value
Quality
Chang...
Offset
Handli...
ST_REV 1 Good:Non Specific:Nc 1 RO
TAG_DESC SN# 1854 : Sync Main Good:Non Specific:Nc 2 RW
STRATEGY 0 Good:Non Specific:Nc 3 RW
ALERT_KEY 0 Good:Non Specific:Nc 4 RW
MODE_BLK 5
BLOCK_ERR <None> Good:Non Specific:Nc 6 RO
UPDATE_EVT 7
BLOCK_ALM 8
TRANSDUCER_DIRECTOR 0 Good:Non Specific:Nc 9 RO
TRANSDUCER_TYPE <Undefined> Good:Non Specific:Nc 10 RO
XD_ERROR None. Good:Non Specific:Nc 11 RO
COLLECTION_DIRECTORY 0 Good:Non Specific:Nc 12 RO
FUNCTION_IDS Sync_Main. Good:Non Specific:Nc 13 RW
UPDATE_TIME 1000 Good:Non Specific:Nc 14 RW
ACTUAL_LINK_ADDRESS_0 Good:Non Specific:Nc 15 RO
CONF_LINK_ADDRESS_1 0 Good:Non Specific:Nc 16 RW
ACTUAL_LINK_ADDRESS_2 92 Good:Non Specific:Nc 17 RO
CONF_LINK_ADDRESS_2 0 Good:Non Specific:Nc 18 RW
ACTUAL_LINK_ADDRESS_2 93 Good:Non Specific:Nc 19 RO
CONF_LINK_ADDRESS_3 0 Good:Non Specific:Nc 20 RW
ACTUAL_LINK_ADDRESS_2 94 Good:Non Specific:Nc 21 RO
CONF_LINK_ADDRESS_4 0 Good:Non Specific:Nc 22 RW
SELECT_IDS 0 Good:Non Specific:Nc 23 RW
Cancel Edit
Edit
Clear
Close
Help

Figure 17.2 – TAG_DESCRIPTION parameter shows the DF51 Serial Number

FUNCTION_IDS
This is the unique parameter to be configured. The user must assign one module to be the **Main** setting **Sync_Main***.* After that, through the synchronism path the other one automatically will be set as **Backup**. This designates physically who should be, in other words, the Preferential and the Redundant processor module respectively. This way, **Main** and **Backup** can be understood simply as labels.

RED_ROLE_L / RED_ROLE_R
It reflects the configuration made at **FUNCTION_IDS**, identifying the **Role** of the module, **Sync_Main** or **Sync_Backup**.

RED_STATE_L / RED_STATE_R
Active - runs all the tasks and generates all the data.
Standby – does not run the tasks, but just receives all the data generated by the other one and stands ready to assume, if necessary.
Not Ready – redundancy is not available.

The different failures that may occur in such system, lead it to a switch over, when the **Standby** becomes **Active** and vice-versa in a bumpless way. The possible reasons for a switch over, divided in two types, are as follows:

General Failures

When the whole processor module fails, this comprises:

- Hardware failure
- Power off
- Removal of the processor module from the backplane.

Bad Condition Failures
When one of the processor module interfaces fails:

- Modbus communication failure (hardware or cable; in case of operating as master).
- H1 channel failure (hardware or cable).

The system is capable of checking which one has the best conditions, electing it as the **Active**.
It is certain the recovery of one failure at a time. That is, once a fail has occurred, a second fail will be recovered by redundancy just if the first fail has been fixed. While the failure is not fixed, the system has the redundancy not fully available (in case of **Bad Condition Failures**) or even not available (in case of **General Failures**).

For the case of **General Failures**, as soon as the failed module recovers a healthy state or is replaced, the modules automatically become a redundant pair again. That is, the system automatically recognizes a new inserted module.

RED_SYNC_STATUS_L / RED_SYNC_STATUS_R

This parameter reflects all the possible status of the synchronism between the modules.

SYNC STATUS	DESCRIPTION
Stand Alone	Just one module is operating. If the system has been synchronized at least once, and this value appears, it indicates that the other module had a General Failure.
Synchronizing	The modules are checking their configuration with each other in order to reach the Synchronized status. It can take up to 9 minutes at maximum (while the system waits for the module in "Not Ready" state get its live lists completed).
Updating Remote	Just after the download of the configuration, the module transfers the whole configuration to the other one through the synchronism path.
Maintenance	The module is being configured by the other module through the synchronism path or by the **Syscon**. If it appears for both "L" and "R" parameters it indicates that none of the modules have been configured.
Synchronized	The modules are in perfect synchronism. The Active continuously updates the Standby databases.

SYNC STATUS	DESCRIPTION
Warning: Role Conflict	If a spare module is connected in the panel with the same Role of that one is already running, this warning is shown. The procedure to fix this conflict is to perform a Factory Init in the spare module.
Warning: Sync Cable Fail	If a failure occurs in the synchronism cable, this warning is shown. The system will not have the redundancy until the synchronism cable is fixed.
Warning: Updating Remote Fail	If a failure occurs in the transfer of configuration from the Active to the Standby, this warning is shown. The procedure is to perform a Factory Init in the module that is not Active and wait until the transfer is completed successfully.

RED_BAD_CONDITIONS_L / RED_BAD_CONDITIONS_R

It can present one or more value (concatenated) as follows:

BIT	BAD CONDITION	DESCRIPTION
0	Modbus	When working as master and if no Modbus slave device answers, it means that Modbus communication is in bad conditions. It can be caused by failures on the communication path or even a failure on the slave.
1	H1-1	Indicates failure on an H1 channel, specifying each channel had the failure.
2	H1-2	
3	H1-3	
4	LiveList	Indicates that the some Live List was not completed.

The desirable and most probable value is <**none**> for both modules (L and R), which assures good conditions for both, and therefore, redundancy fully available. This parameter can have two functions as follows:

A **Bad Condition failure** for the Active module leads the system to a switch over. In this case, this parameter acts as record of the reason of the last switch over.

When a **Bad Condition failure** occurs for the standby module this parameter shows this condition as an alarm. Thus, warning the operator that the standby presents a specific problem, it allows proactive maintenance in order to have redundancy fully available.

RED_MAIN_WDG / RED_BACKUP_WDG

These are watchdogs that indicate the communication status between the HMI and the processor modules. While their values are incrementing within 2 seconds the respective network connections (Main and Backup) are working fine.

As a simple rule, the redundancy is fully available, ONLY if the modules are **Synchronized** and have <**none**> in **BAD_CONDITIONS** parameters (L and R).

The following operations can be performed without process interruption: replacing a module with failure, fixing the system when the H1 cable breaks, firmware update, and adding redundancy to a system in operation.

NOTE
The most new DF51 modules have a LED labeled as “Standby” at the front to indicate the redundancy state of the module. When the LED is “on”, it means that the module is in standby. When the LED is “off”, the module may be either in **Active** or **Not Ready**. If one of the modules is in **Standby**, the other is surely in **Active**.

In the next paragraph there are some steps for the Hot Standby Redundancy configuration and maintenance. It is recommended that the steps are all read and understood before are executed.

First time configuration procedure

This is the procedure to configure the system with Hot Standby Redundancy for the first time, at the plant start-up.

1 - With the H1 connector disconnected, execute a Factory Init in both modules in order to grant the default state.

2 - Connect both modules together, through the H1 channels (1 to 4).

3 - Open the desired configuration in the **Syscon** and put it in **On-line mode**. Right-click the **bridge** icon and in the option **Attributes** choose one of the modules listed in the field **Device Id**. The chosen module will be that one to be configured as **Main**. In the main window, right-click the icon and then select **Export Tags** option on the popup menu.

4 - Even in the bridge icon, right-click the field **FB VFD,** and then choose **Block List**. A new window will open showing all the blocks pre-instantiated in the module. In this window, right-click the **transducer** performing an **Assign Tag** with the tag that is predicted in the configuration. Close the **Block List** window.

5 - Right-click the **transducer** icon in the **bridge** and choose **On Line Characterization** (see note about operation modification of DF51 in the **SYSTEM302** V7.x or higher). Set the parameter **FUNCTION_IDS** as **Sync_Main**. Through the synchronism path, the other module automatically will be initialized as **Backup**. After that, both the parameters **RED_SYNC_STATUS** (L and R) will indicate **Maintenance**, which means that neither of the modules was configured yet.

6 - If necessary, perform **Assign Tag** for all the field devices. Wait until the Live Lists of all the channels are complete. So, configure the system through the Active module executing all necessary downloads exactly the same way for a non-redundant DFI302 system.

7 – As soon as downloads are completed successfully, the transducer will show the following phases:

- The Active will transfer the whole configuration to the other module (**RED_SYNC_STATUS_L** as **Updating Remote** and **RED_SYNC_STATUS_R** as **Maintenance**).
- After the configuration is successfully transferred, the modules can take some time to synchronize (**RED_SYNC_STATUS** parameters (L and R) as **Synchronizing**). This is the time necessary to the modules to check the configuration with each other.
- Finally, the modules will synchronize (**RED_SYNC_STATUS** parameters (L and R) as **Synchronized** and **RED_STATE_R** as **Standby**). Once the system is on these conditions, the Active will be constantly updating the Standby.

NOTE
About operation modification of DF51 in the System302 V7.x or higher Any change of name and number of blocks in DF51 will only be recognized by **SYSTEM302** v7.x after new startup of OPC Server. This is due to change in the default configuration of TOPOLOGY_CACHE = ON parameter in the configuration file SmarOleServer.ini. Firmware version V3.9.5 or higher eliminates the need to restart the OPC server.

Changing the configuration

Just follow the steps 6 and 7 of the section "First time configuration procedure".

Replacing a module with failure

1 - With the H1 connector disconnected, insert the new module in the backplane.

2 - Update the firmware in the new module, if necessary. Perform a Factory Init in the new module in order to grant the default state.

3 - Connect the H1 connector to the new module.

4 - The new module will be automatically recognized by the Active and both will stay in Synchronizing for some time. As soon the system get the **Synchronized** status and <**none**> in the **BAD CONDITIONS** parameters, the redundancy will be fully available and failure simulations can be performed.

Fixing the system when the H1 cable breaks

If a fail occurs in a segment of H1 line such that it affects only one module, the redundancy will cover this fail. But, if the H1 cable is reconnected at once, the noise introduced in the line will cause communication problems for some time. In order to avoid that problem, follow the procedure below.

1 - Put the module affected by H1 cable fail in **Hold**.

2 - Fix up the cable connection.

3 - Perform a Reset in the affected module in order it returns operating. The module will be automatically recognized by the Active and both will stay in Synchronizing for some time. As soon the system get the **Synchronized** status and <**none**> in the parameters **BAD CONDITIONS**, the redundancy will be fully available and failure simulations can be performed.

Firmware update without process interruption

This procedure describes how to update the firmware of both the modules without process interruption.

1 – Be sure the system is in the **Synchronized** status and it has <**none**> in the parameters **BAD CONDITIONS.** So, use **FBTools** to update the firmware of the Active module. At this moment, the other module will take over.

2 - After the firmware update was finished, the modules will start to synchronize with each other, with the Active transferring all the configuration to the other one. Wait for the system get the **Synchronized** status and it has <**none**> in the **BAD_CONDITIONS** parameters.

3 - Use **FBTools** to update the firmware of the Active module. At this moment, the other module will take over.

4 - After the firmware update was finished, the modules will start to synchronize with each other, with the Active transferring all the configuration to the other one. As soon the system get the **Synchronized** status and has <**none**> in the parameters **BAD_CONDITIONS**, the redundancy is fully available again and failure simulations can be performed.

Adding redundancy to a system in operation

If a non redundant system is intended to be redundant in the future, at the plant start-up, the following conditions must be obeyed:

1 - The 4^{th} H1 port should be reserved as synchronization path. That is, this port should not have devices connected to it.

2 - Predict H1 channels cabling considering that a Backup module will be added in the future (the H1 channels of the Main module should be connected in parallel with the respective H1 channels of the Backup module).

3 - Predict that the LAN architecture can be expanded, in order to attend what is described in the Redundant System Architecture.

4 - The single module should use a redundant firmware (a version terminated in R). The **FUNCTION_IDS** parameter should be set as **Sync_Main**. This way the module will work in **Stand Alone** state and will be ready to recognize a new pair inserted at any time.

Obeying these conditions, redundancy can be added at a later time without process interruption. The procedure to add redundancy to the system is just follow the same steps described in the section “Replacing a module with failure”.

Configuring LAS Redundancy

In the next paragraph there are some steps for the configuration and maintenance of this legacy mode. It is recommended that the steps are all read and understood before are executed.

First time configuration procedure

This is the procedure to configure the system with LAS Redundancy for the first time, at the plant startup.

Active Module

1 - With the H1 connector disconnected, execute a Factory Init in both modules to grant the default state.

2 – Connect the H1 connector to the Active module. Keep the Backup module with the H1 connector disconnected for a while.

3 - Open the desired configuration in the **Syscon** and put it in **On-line** mode. Right-click the **bridge** icon and with the option **Attributes** choose the module to be configured as **Active** in the field Device Id.

4 - Even in the bridge icon, right-click the field **FB VFD,** and then click **Block List**. A new window will be opened showing all the blocks preinstantiated in the module. Then, in this window, right-click the **transducer** performing an **Assign Tag** with the tag that is predicted for the Active in the configuration. Close the **Block List** window. In the main menu go to **Export** and click **Tags**.

5 - Right-click the **transducer** icon in the bridge and choose **On Line Characterization** (see note about operation modification of DF51 in the **SYSTEM302** V7.x or higher). Set the **FUNCTION_IDS** parameter as **Active**.

6 - Even in the transducer, set the **SYSTEM_OPERATION** parameter as **Redundant**.

7 - If necessary, perform Assign Tag for all the field devices. Wait until the Live Lists of all the channels are complete. So, configure the system through the Active module executing all necessary downloads exactly the same way for a non-redundant DFI302 system.

NOTE
About operation modification of DF51 in the SYSTEM302 V7.x or higher Any change of name and number of blocks in DF51 will only be recognized by **SYSTEM302** v7.x after new startup of OPC Server. This is due to change in the default configuration of TOPOLOGY_CACHE = ON parameter in the configuration file SmarOleServer.ini. Firmware version V3.9.5 or higher eliminates the need to restart the OPC server.

Backup module

IMPORTANT – before connecting the H1 connector to the Backup module, follow the steps below:

1 - Right-click the **bridge** icon and with the option **Attributes** choose the module to be configured as Backup in the field Device Id.

2 - In the configuration change temporarily the tag of the transducer (Backup must have it different from that one used for Active). In the main menu go to **Export** and click **Tags**.

3 - Even in the bridge icon, right-click the field **FB VFD** and then click **Block List**. A new window will be opened showing all the blocks pre-instantiated in the module. Then, in this window, right-click the **transducer** performing an **Assign Tag** with the tag that is predicted for the Backup in the configuration. Close the **Block List** window.

4 - Right-click the **transducer** icon in the bridge and choose **On Line Characterization**. Set the **FUNCTION_IDS** parameter as **Passive**.

5 – And then, connect the H1 connector to the new module, and after that set the **FUNCTION_IDS** parameter as Backup.

6 - Even in the transducer, set the **SYSTEM_OPERATION** parameter as **Redundant**. Wait until the Live Lists of all the channels are complete.

7 - For each one of the channels used in the configuration right-click the **Fieldbus** icon and choose the option **Download Schedule**.

NOTE
The **SCHEDULE_UPDATE** parameter in the transducer should not be used anymore. Instead of it use the option **Download Schedule** as described in the step above.

Replacing an Active module with failure

If the Active module fails, the Backup module takes over as LAS (Link Active Scheduler).

This is the procedure for the case the Active module must be replaced:
1 - With the H1 connector disconnected, insert the new module in the backplane.

2 - Update the firmware in the new module, if necessary. Perform a **Factory Init** in the new module in order to grant the default state.

IMPORTANT- before connecting the H1 connector to the new module, the user must follow the steps below:

3 - Open the desired configuration in the **Syscon** and put it in On-line mode. Right-click the **bridge** icon and with the option **Attributes** choose the module to be configured as **Active** in the field **Device Id**.

4 - Even in the bridge icon, right-click the field **FB VFD** and then click **Block List**. A new window will be opened showing all the blocks pre-instantiated in the module. Then, in this window, right-click the **transducer** performing an **Assign Tag** with the tag that is predicted for the Active in the configuration. Close the **Block List** window. In the main menu go to **Export** and click **Tags**.

5 – Right-click the **transducer** icon in the bridge and choose **On Line Characterization**. Configure the **FUNCTION_IDS** parameter as **Passive**.

6 – And then, connect the H1 connector to the new module, and after that set the **FUNCTION_IDS** parameter as **Active Not Link Master**.

7 – Even in the transducer, set the **SYSTEM_OPERATION** parameter as **Redundant**. Wait until the Live Lists of all channels are completed.

8 - For each one of the channels used in the configuration right-click the **Fieldbus** icon and choose the option **Download Schedule**.

9 – Change the **FUNCTION_IDS** parameter from Active Not Link Master to **Active**.

Replacing a Backup module with failure

If the Backup module fails the Active module remains as LAS (Link Active Scheduler).

The procedure for the case the Backup module must be replaced is the following:
1 - With the H1 connector disconnected, insert the new module in the backplane.

2 - Update the firmware in the new module, if necessary. Perform a Factory Init in the new module in order to grant the default state.

IMPORTANT – before connecting the H1 connector, the user must follow the steps below:

3 – Right-click the **bridge** icon and with the option **Attributes**, choose the module to be configured as **Backup** in the **Device Id** option.

4 – In the configuration, change, for a while, the transducer tag (the Backup module must have a different tag in comparison with the Active). In the **Syscon** main menu, go to **Export** and click **Tags**.

5 – Even in the **bridge** icon, right-click **FB VFD**, and then click **Block List**. A new window will open showing the pre-instantiated blocks in the module. So, in this window, right-click in the **transducer** to do an **Assign Tag** with the tag that is the Backup in the configuration. Close the **Block List** window.

6 – Right-click in the **bridge** icon of the transducer and choose **On Line Characterization**. Configure the **FUNCTION_IDS** parameter as **Passive**.

7 – And then, connect the H1 connector to the new module, and after that set the **FUNCTION_IDS** parameter as **Backup**.

8 – Even in the transducer, configure the **SYSTEM_OPERATION** parameter as **Redundant**. Wait until the Live Lists of all channels are completed.

9 – For each one of the channels used for the configuration, right-click in the **Fieldbus** icon and choose the **Download Schedule** option.

Placing the system into operation after a general power failure

There is also a procedure to place the modules into operation after both have been turned off. If you turn them on at the same time, there will be many collisions on the H1 network because both modules (Active and Backup) will try to become the LAS at the same time. It will cause a delay for the perfect communication to be established. In order to avoid this problem, turn on first the Active module and wait until it is on line. Then, turn the Backup module on.

Fixing the system when the H1 cable breaks

If a fail occurs in a segment of H1 line such that it affects only one module, the redundancy will cover this fail. But, if the H1 cable is reconnected at once, the noise introduced in the line will cause communication problems for some time.

In order to avoid that problem, follow the procedure below.
1 - Put the module affected by H1 cable fail in Hold.

2 - Fix up the cable connection.

3 - Perform a Reset in the affected module in order it returns operating. The redundancy will be fully available and failure simulations can be performed.

Firmware update without process interruption

This procedure describes how to update the firmware of both the modules without process interruption.

1 - Use **FBTools** to update the firmware of the Active module. At this moment, the other module will take over.

2 - After the firmware update had finished successfully, follow the steps 4 to 9 of "Replacing an Active module with failure".

3 – Wait around one minute in order the Active module become the LAS again (the Active is always the preferential in this mode of redundancy).

4 - Use **FBTools** to update the firmware of the Backup module.

5 – After the firmware update had finished successfully, follow the steps 1 to 6 of the section "Configuring the system for the first time- Backup Module".